CONSTRUCTORS' GUIDE

XH79L

This guide is intended as a general-purpose introduction to electronics construction at home. It is not specific to this or any other kit, but some of the information in this leaflet may well be useful to you during construction. Beginners should read *all* of this leaflet before commencing construction.

'Get-You-Working' Service

This is a service we sincerely hope you never have to use. Of all the kits returned to us for repair, only about 1 return in 20 really needed our help! 5% of kits returned are faulty due to one or more components inserted the wrong way round. 10% are due to the right value components being inserted in the wrong places; usually two are simply transposed. But a staggering 80% of all the kits returned are faulty simply because of *poor soldering.* So please do check these three points very carefully.

If you still cannot find the fault then please return the whole completed project, not just the faulty board (if it is a large project) as faults on one board are often caused by problems on another board in the project. Enclose a cheque or PO for approx 10% (minimum £17) of the cost of the components, or kit, being returned. If the boards arrive damaged by the Post Office, they will be returned to you with your money after deducting the return postage.

Under no circumstances will we be liable for damage to goods sent to us. In addition, we will not attempt a repair if the quality of construction is so poor that the only answer is a complete rebuild. Again, the package will be returned to you with your money after deducting the return postage. If the fault is due to faulty components, or incorrect instructions, or any error on our part which could have led to the fault, we will repair the board and return it to you carriage paid with a refund of your fee and your postage to us.

If the fault is due to an error or errors you have made, we will charge you for our time at a reasonable rate, and for the cost of any parts replaced. If this is less than the amount you sent, we will refund the difference after deducting the cost of postage to you. If the cost including return postage is more than the amount you sent, we will ask you to pay the difference before the goods are returned. But remember that it can take our engineer up to an hour (or much more on large projects) to set up the necessary test jig that will enable him to start testing your particular project, and then can take him some time to find the fault. So if you are not actually prepared to pay our very reasonable charges, then please do not return your projects for repair!

We will make the repair as fast as we possibly can, but please allow 3 weeks. We will acknowledge receipt of your parcel by return of post (second class).

Soldering

Good soldering is a skill that is learned by practice and it is most important that you learn this skill before starting this project.

The main point to remember is that both parts of the joint to be made *must* be at the same high temperature. The solder will flow evenly and make a good electrical and mechanical joint *only* if both parts are at an equal high temperature. In most kits, almost all the solder joints to be made are between a component wire and a printed circuit track, so in this case both the wire *and* the track must be at the same high temperature before the solder is applied. Even though there is a metal to metal contact, very often a film of oxide on the surface is enough to insulate the two parts; it is no good applying the soldering iron tip to the component wire only and expecting this to heat the pcb track as well. Before attempting this project, practice soldering using a piece of stripboard and some surplus resistors or scrap components – *don't use components from or practice with this kit!*

The first thing you'll need is a good soldering iron. There are plenty to choose from such as the

Antex XS or CS which both have a fairly high wattage to help the heat flow quickly into the joint so that the heat need be applied for only a short time. Many semiconductor and plastic packages can be damaged by excessive heat. Joints should be formed with this fact in mind.

When the iron is hot, apply some solder to the flattened working area at the end of the bit, and wipe it with a piece of cardboard or damp cloth so that the solder forms a thin film on the bit. Always use a good quality solder. A standard 60% tin, 40% lead alloy solder with cores of noncorrosive flux will be found the easiest to use.

If the wires of the component to be fitted are parallel to one another and on the same side of the component ('radial'), they should fit directly into the pcb without bending, but if the leads are located at opposite ends or sides of the component ('axial'), they should first be bent at right angles close to the body of the component. Push the leads through the pcb from the legend side, and splay out the ends of the leads a little on the track side so that the component does not fall out when the board is turned over for soldering, and so that the wire touches the edge of the copper track. Be careful that the wire does not also bridge across to close adjacent tracks however, or these will be soldered too, creating a 'solder bridge' type of short circuit.

Transistors and tantalum capacitors should be mounted such that they stand approximately 5mm above the board (see Figure 1). This is to ensure that the short length of lead restricts the flow of heat to the component. Sometimes very small bore sleeving, such as insulation stripped from hook-up wire, can be cut to 5mm lengths and slipped over these leads, thus maintaining this distance and making it easier to secure the component before soldering. If you are an absolute beginner at soldering, then it may take you a while to become experienced enough to make joints quickly without damage to heat sensitive components, and it may be worth investing in a 'heatshunt' (FR10L, Tools Section, Maplin Catalogue). This is a pair of sprung tweezers which can be attached to each component lead on the component side of the board whilst soldering, and which will draw off excessive heat before it can reach the transistor etc. Other components which do not take kindly to overheating are small, polystyrene capacitors.

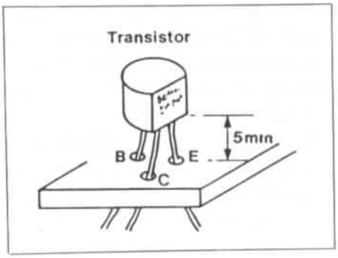


Figure 1

Now melt a little more solder on to the tip of the soldering iron, and put the tip so that it contacts both the copper track and the component wire. It is the molten solder on the tip of the iron that allows the heat to flow quickly from the iron into *both* parts of the joint. If the iron has the right amount of solder on it and is positioned correctly, then the two parts to be joined will reach the solder's melting temperature in about half a second. Now apply the end of the multicore solder to the point at which the copper track, component wire, and soldering iron are all touching one another. The solder will melt immediately and flow around all the parts that are at, or over, the melting point temperature. It should be possible to take the iron away within one and a half seconds of first touching the iron to the joint.

Try not to leave the soldering iron in contact for much longer than two or three seconds. If you fail to complete the joint in this time then remove the iron and leave the pcb to cool for 10 to 15 seconds, then repeat the operation. This precautionary measure will much reduce the risk of heat damage, which can go so far as to affect the pcb and tracks as well as the electrical components. Also this technique of allowing a cooling period between operations would not come amiss where many joints are to be made rapidly and in the same small area, e.g. soldering DIL IC sockets, etc.

Make sure that the wire and pcb do not move after the soldering iron is removed until the solder is completely hard. This should happen within 5 to 10 seconds. If one of the components moves during this cooling period, the joint may be seriously weakened. If necessary the component may have to be supported during the cooling period.

The hard cold solder on a properly made joint will have a smooth shiny appearance and if, on a practice joint, the wire from the joint is pulled, the wire should not pull out of the joint. It should be possible to pull the copper track up off the Veroboard by pulling on the wire. In a properly made joint, the solder will bond the wire to the copper track very strongly indeed, since the process is akin to brazing and, to a lesser degree, welding, in that the solder actually forms a molecular bond with the surfaces to be joined.

It is also important to use the right amount of solder, both on the iron and on the joint. Too little

solder on the iron will result in poor heat transfer to the joint, too much and you will suffer from the solder forming strings as the iron is removed, causing splashes and bridges to other tracks, and once a large 'blob' has established itself as a solder bridge it can be quite awkward to remove. Too little solder applied to the joint will give the joints a half finished appearance: a good bond where the soldering iron has been, and no solder at all on the other part of the joint. Ensure solder completely surrounds the wire or component lead and no gaps are visible when viewing against a light source. Too much solder applied to the joint will cause bridging when adjacent points are soldered. Also, note that the flux contained in the longitudinal cores of the multicore solder (hence the name of this type) is a chemical designed to clean the surfaces to be joined of deposited oxides, and exclude air during the soldering process, which would otherwise prevent these metals from coming together. Consequently, don't expect to be able to complete a joint by using the application of the tip of the iron loaded with molten solder alone, as this usually will not work. Having said that, however, there is a process called 'tinning' where conductors are first coated in fresh, new solder prior to joining by a hot iron.

Now with all this in mind, make and test solder joints over and over again on a piece of Veroboard until you are making good solid joints every time. Remember it is much, much more difficult to correct a poorly-made joint without damaging something, than it is to make the joint properly in the first place. Anyone can learn to solder properly, it just takes practice.

When you are quite sure that you have mastered the art of soldering, you are ready to start the construction of this kit.

Getting Started

It is advisable first to sort out all the components and check them off against the Parts List. If any part is missing, please accept our apologies for the inconvenience; write to, or telephone our Sales Department, and we will send on the missing parts at once. If any parts are over, please keep them with our compliments. It is very unlikely that you will have received an incorrect part, but if you do have an item over and an item not received and you don't think the extra item is the part you need, first check carefully to ensure that there are no additional notes with the kit explaining the exchange, then double-check every other part to ensure you have identified them correctly. If you still think we've got it wrong, write to, or telephone our Sales Dept (but not any of our shops) giving the kit number, our description of the part missing and a clear description of the part you have over.

How to Identify Components

Resistors

By the middle of 1986 all the resistors in our kits should have three colour bands for the value, followed by a brown band to indicate 1% tolerance, and then a red band to indicate a 50ppm temperature coefficient. A colour code chart for these new style resistors is shown in Table 1.

The first band on the body of the resistor indicates the first figure of the value, the second band indicates the second figure of the value. The third band indicates the amount by which the first two numbers must be multiplied (except for Gold and Silver, it may be easier to remember that band 3 may be read in the same

Colour	Band 1 1st Figure	Band 2 2nd Figure	Band 3 Multiplier	Band 4 Tolerance	Band 5 Temperature Coefficient
Black	0	0	x1		200ppm
Brown	1	1	x10	1%	100ppm
Red	2	2	x100	2%	50ppm
Orange	3	3	x1000		15ppm
Yellow	4	4	x10,000		25ppm
Green	5	5	x100,000	0.5%	
Blue	6	6	x1,000,000	0.25%	10ppm
Violet	7	7	x10,000,000	0.1%	5ppm
Grey	8	8			1ppm
White	9	9			
Gold			x0.1	5%	
Silver			x0.01	10%	
None				20%	

Examples

Band 1	Band 2	Band 3	Band 4	
Brown	Black	Black	Brown	= 10 x 1 = 10Ω at 1%
Red	Violet	Gold	Gold	= 27 x 0.1 = 2.7Ω at 5%
Green	Blue	Yellow	Brown	= 56 x 10,000 = 560kΩ at 1%
Grey	Red	Green	Brown	= 82 x 100,000 = 8.2MΩ at 1%

Table 1

way as band 1 and 2, i.e. that Red = 2, Orange = 3, etc – except that in this case, it indicates the number of *zeros* which follow the first two numbers – Black means no zeros).

The fourth band indicates the tolerance, and the fifth band, the temperature coefficient, see Figure 2.

Figure 2

If there is a fifth band on our resistors, it will always be red indicating 50ppm. (Note that k = thousand, M = million, Ω = ohms.)

On the *old-style* five-band resistors we have sold (i.e. the 0.4W min res), the third band will always be black, and may be disregarded, and the fifth band is always brown. To find the value, *disregard* the black third band, and read the other bands as you would for a four-band resistor, but finally multiply the value obtained by ten. For example:–

Red, Violet, Black, Brown, Brown, (disregarding band 3)
= Red, Violet, Brown, Brown
= 27 x 10 at 1% = 270 at 1%.

Then multiply by ten:
270 x 10 = 2700 at 1%.
Value is 2700 (2k7).

In the case of 5% carbon film resistors, the gold tolerance band always indicates that the value must be read from the other end, but with the 1% 4-band and the old-style 5-band metal film resistors, confusion can arise because the 1% band is brown, and the first number on the other end can be brown as well!

Note however that these resistors have the tolerance band in a position which should be offset from all the other bands on the resistor's body, with a wider gap between it and the others, but if you are uncertain, the only thing to do is to find the value of the resistor using an ohmmeter. Our new 5-band resistors cannot be mis-read however, since if reversed, the first two bands will be: red, brown = 21, and there are no standard resistor values which begin with '21'.

Capacitors

Identifying capacitors can be difficult, as different manufacturers of even the same kind of capacitor often use different marking systems. But in general, if they are not in plain English, then they are marked in one of the two following ways:

1. They have two numbers and a letter p, n or μ. The letter replaces the decimal point, so that 10p = 10pF; 2n2 = 2.2nF (2200pF); $3\mu3$ = 3.3μF; 100n = 0.1μF; 10n = 0.01μF or 10,000pF; n47 = 0.47nF = 470pF etc.

2. They have three numbers. The first two numbers are the value and the third number indicates the number of zeros, and the whole number is the value in picofarads (pF). Thus 102 = 1000pF (10 + '0'x2, same as 1nF or 0.001μF); 473 = 47,000pF (47 + '0'x3, same as 47nF or 0.047μF); 105 = 1μF (10 + '0'x5, 1,000,000pF, i.e. 1 then 0 then five more 0's).

In addition, capacitors often have a capital letter after the value, e.g. 2n2K or 102J. This letter indicates the tolerance. F = ±1%, G = ±2%, H = ±2½%, J = ±5%, K = ±10% and M = ±20%.

Multiplication Factors

To avoid writing long unwieldy numbers, electronics values are usually written using a multiplication factor. For example, 10,000 would be written 10k, where k = a thousand or $x10^3$. The whole range of multiplication factors is shown below.

	1a	= $x10^{-18}$	(atto)
1000a =	1f	= $x10^{-15}$	(femto)
1000f =	1p	= $x10^{-12}$	(pico)
1000p =	1n	= $x10^{-9}$	(nano)
1000n =	1	= $x10^{-6}$	(micro)
1000 =	1m	= $x10^{-3}$	(milli)
1000m =	1	= $1(x10^0)$	–
1000 =	1k	= $x10^3$	(kilo)
1000k =	1M	= $x10^6$	(mega)
1000M =	1G	= $x10^9$	(giga)
1000G =	1T	= $x10^{12}$	(tera)
1000T =	1P	= $x10^{15}$	(peta)
1000P =	1E	= $x10^{18}$	(exa)

Orientation of Components

Identify resistors with reference to the parts list and p.c.b. overlay. Make sure that the correct values are recognised with the aid of a resistor colour code chart if necessary. Install all the resistors one at a time by inserting into the position indicated on the legend, bending the wires to right angles to facilitate insertion and then folding them over underneath prior to soldering. Trim off excess wire using side cutters.

Although with many components (resistors for example) it does not matter which way round they go; there are equally as many components where correct orientation is absolutely vital. Some common types are tantalum and electrolytic capacitors, diodes, and all semiconductors. Tantalum and some miniature electrolytic capacitors have a '+' sign on the body of the component adjacent to one of the leads, usually the longer of the two (see Figure 3). Always ensure that this lead goes into the hole in the pcb which has a '+' sign printed next to it. In the case of

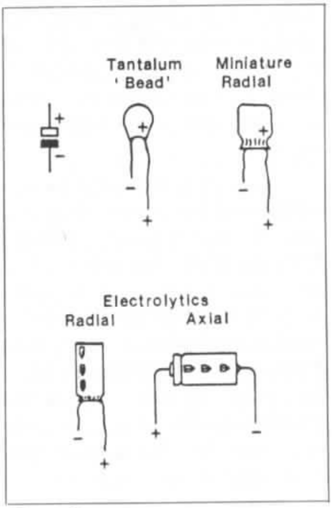


Figure 3

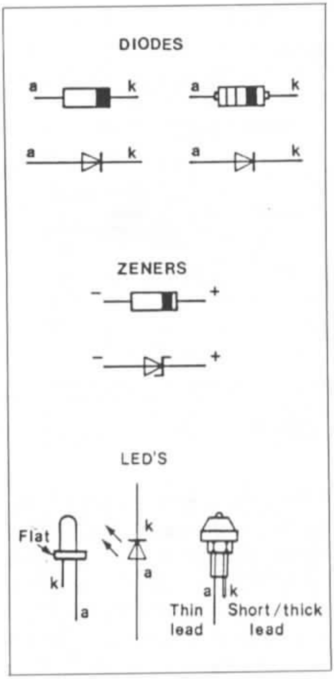


Figure 4

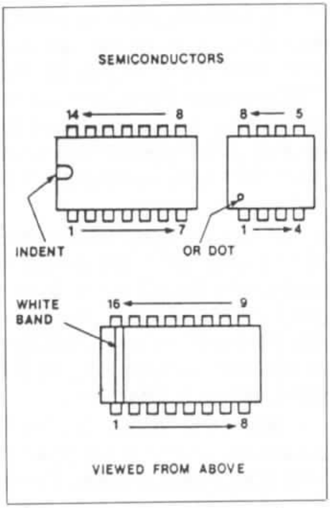


Figure 6

most electrolytics, both the vertical PC mounting and axial types have a '–' sign pointing to the negative or case connected lead, which is usually the shortest lead with PC types, and the longest with the axials.

Diodes usually have a thicker coloured band at one end which denotes the cathode, or 'K', and this should line up with the thick band marked on the legend. For more information on diode and transistor orientation, look up 'Transistor Cases' in the index of our current catalogue (see Figures 4 and 5). Bear in mind that transistor packages are usually drawn as viewed from *below*, whereas integrated circuits (IC's) are invariably drawn viewed from *above*. To find pin 1 of an IC, hold it so that the writing on the top of the package is the right way up to read, then pin 1 will be the lower far left pin. In addition this end of the package is normally marked with a semicircular or rectangular indent, and/or pin 1 itself may also be marked with an indented or printed dot or a '1', see Figure 6. Upon fitting to the pcb, this indent *must* align with the white marker block shown on the legend, otherwise the device will be connected wrongly into the circuit and almost certainly destroyed, so be sure to fit them the right way around. If the components in this kit do not follow the general rules above, then this will be specifically brought to your attention in the construction details.

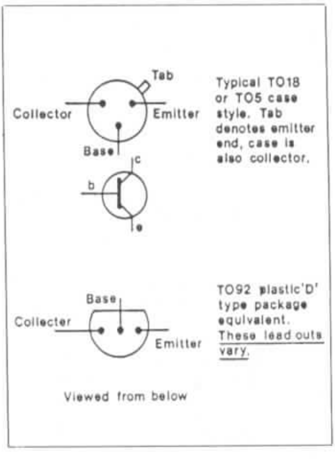


Figure 5

Handling Semiconductors

Generally speaking, semiconductor devices are usually the last components to be assembled onto the pcb; this better ensures minimum risk of thermal or static damage as a result of further work on the pcb. It is advisable to handle semiconductors as little as possible. Semiconductors (especially CMOS), which we have supplied specially packed, should not be unpacked until you are ready to fit the part to the pcb. CMOS ICs and MOSFET transistors require special handling precautions; you must avoid a heavy build-up of static electric charge between yourself and the device or the work area. Avoid touching the pins of CMOS devices, but if you have to, then we recommend that you work on a metal tray connected via a 1MΩ resistor to earth, to ensure that any static potentials around the work area are equalised. Hold the IC with thumb and forefinger at the ends, and touch the lead-out pins as little as possible. However, you may need to squeeze the pins slightly to ensure that the IC will push easily into its socket.

If you keep one hand in contact with the tray, then you can use your other hand to pick up the CMOS device. If you have to use both hands, then you will have to arrange a tightly fitting metal wrist strap electrically connected to the tray.

If you are using IC sockets, always ensure that the socket is soldered to the pcb before inserting the IC. It is advisable to use the DIL integrated circuit holders, or sockets, provided in the kit where specified for devices.

Note that some MOSFET transistors have a coil of springy wire around all their leads, this is to temporarily short any static charges between leads. You must *not* remove this wire until the device is soldered into circuit.

Linking on PCB's

Four methods are generally used to make track connections on our pcb's:

(1) Wire Links; (2) Track Pins; (3) Plated-through Holes; (4) Vero Pins.

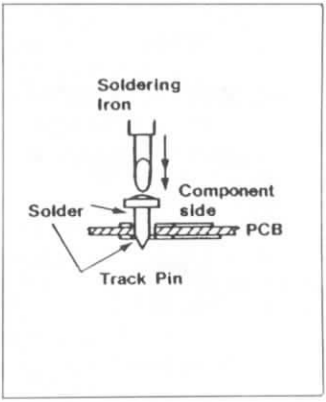


Figure 8

Of these four, the third is the easiest to work with. Each hole is plated through from both sides such that a conductive layer connects both sides together, and components soldered to one side will be connected through to a track on the other side without further fuss, see Figure 7.

Track pins are usually inserted into holes marked with a circle; the heads are pushed down onto the pcb pad with a hot soldering iron, and both sides of the track pin are soldered in place, thus connecting the tracks on each side of the board, see Figure 8.

Vero pins are used for terminating wires to or from the pcb. These too, are inserted from the *track side* of the board and their heads pushed down onto the pad with a hot soldering iron, and soldered in place (see Figure 9). Forcing Vero pins into a board by any other means will probably crack the pcb, or introduce hair line fractures in surrounding tracks.

Wire Links are called for occasionally, and these can be fashioned out of left over component leads, or from tinned copper wire, available on small reels; 24 gauge is generally adequate for this purpose, see Figure 10. If a link lies close to a component, then use insulating sleeving, or alternatively bell wire (e.g. BL85G) in place of t.c.w. for the link.

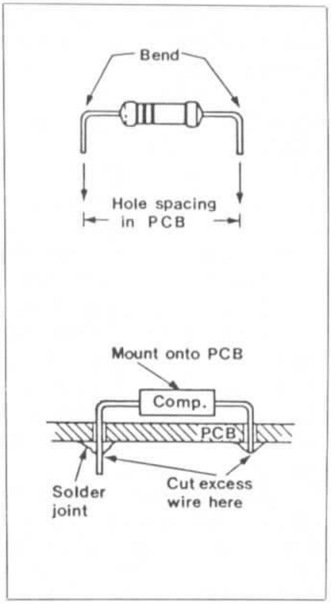


Figure 7

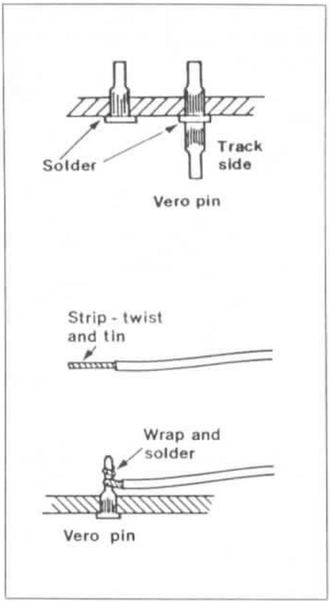


Figure 9

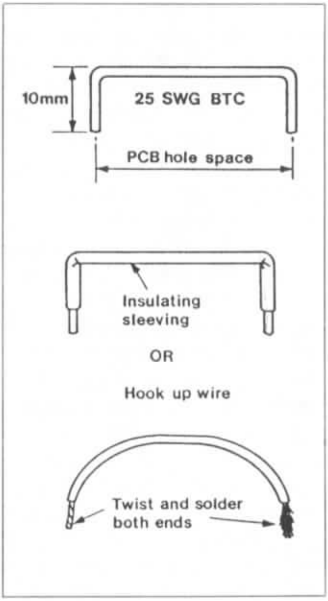


Figure 10

Test Equipment and Tools

Basic tools required for project building are:

1. 18 to 40 Watt soldering iron.
2. Side cutters.
3. Small long nose pliers.
4. Miniature screwdriver.
5. Large flat blade screwdriver.
6. Phillips or posi-driver.
7. Heavy duty pliers.
8. Trimming or alignment tool.
9. Desolder braid or solder sucker.
10. Stiff 1in. paint brush and pcb cleaner.
11. Tin/lead alloy multicored solder.

Useful Accessories:

1. Power drill.
2. Small pcb drills.
3. Insulating tape.
4. Silicone heat transfer compound.
5. Adhesives.
6. Safety mains connector.
7. Small files.
8. Craft knife.
9. Box spanners.
10. Sheet metal punches.
11. Magnifying glass.
12. Hobby box for components.

Test Gear

A good quality multimeter, preferably digital, is necessary to start with. Also oscilloscopes and frequency counters/frequency generators will become necessary for alignment and trouble shooting purposes. Trying to attempt fault finding without these various equipments will be extremely difficult, and it may be preferred to take advantage of our 'get-you-working' service detailed previously.

Maplin projects are thoroughly tried and tested before sale, and components supplied in kits are all guaranteed, but nevertheless, problems may be encountered due to faulty construction, or component failure. If, after following precisely the constructional details, a project does not function, then:

1. Remove the power source and completely inspect all components and soldering.
2. Look particularly for bridging 'whiskers' of solder between tracks, and clean the board with a stiff brush and pcb cleaner.
3. Digital circuits can be complex so try to analyse the circuit along with the circuit description.
4. Use a multimeter to check that supply voltages are correct and do actually reach the various components connected to them by using the meter probes on the component leads themselves.
5. Check for continuity along tracks on the pcb. Using the meter's resistance range on a low ohms setting. Some meters use quite high voltage batteries which may damage semiconductor devices, so beware of this!
6. An oscilloscope is a very good aid to trouble-shooting, providing a detailed, visual display of circuit performance. Often used in conjunction with a signal generator. Likewise, a frequency counter is required for measuring oscillators, clock generators etc., and is important in RF radio work. As with many other things the cost of these instruments is proportional to their real usefulness.
7. Obtain books on the subject and increase your education in Electronics. The benefits can be enormous and will give a greater insight into circuitry and design.
8. Above all, be accurate and do not rush construction. Persevere with the project step-by-step, paying attention to detail. Check your work at every stage; it is much easier to eliminate problems during construction than trying to find them afterwards.

Advice from our technical department can be sought by letter (not by telephone) and full details of all problems encountered, and at what stage, must be included. Detail any wrong voltages or signals apparent, and the final result (or lack of!). We will try to indicate where the fault may be but, due to the very nature of electronics and the interaction of various components with each other, it may not be possible for us to diagnose the fault without access to the unit itself.

Even if you find a problem and overcome it yourself, we would like to hear from you, so that your ideas can be added to a list of customer-related trouble-charts. These 'help sheets' exist for many of our projects, and are available from us.

Data sheets for quite a large number of our semiconductor devices are also available and can greatly assist trouble-shooting for the more experienced constructor.

Mounting Kits

Most power transistors (Bipolar & FET types) require some method of attachment to heatsinks. Figure 11 shows a general method of assembly for plastic packaged devices quite commonly used in projects. The device package has a metal heat-transfer tab which may be connected to one or more terminal pins and therefore, requires that it be electrically insulated from the heatsink. A Mica-washer is used as an insulator as this material has good thermal transfer properties; and silicon based

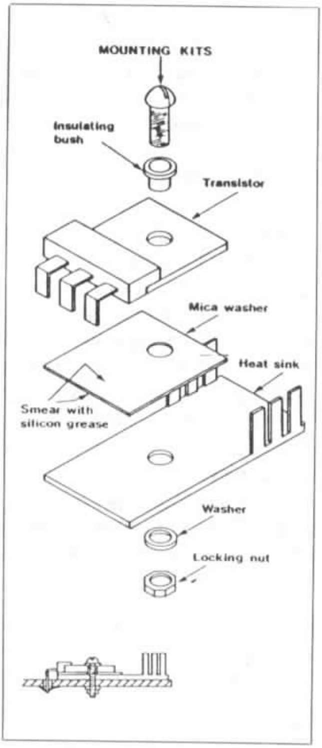


Figure 11

thermal compound is applied to both device and heatsink for maximum contact, by filling any gaps. The fixing bolt also needs to be insulated from the heatsink (or the device), and a small plastic bush is used for this. Most bushes used with the plastic and metal 'T03' style packages require a ½in. x 6BA bolt and nut for fixing the complete assembly. Bolt lengths obviously vary according to the varying thickness of different heatsinks.

Heatsinks

Many constructors seek advice on which heatsink would be suitable for a particular application or component. Unfortunately, the answer is dependent on so many factors that no definite answer can be given.

Heatsinks are usually advertised with a 'degrees per watt' (°C/W) rating, which means that for every watt to be dissipated at the centre of the heatsink, the temperature rises by the given number of degrees. This factor is also determined by enclosure space, air temperature, free air flow and even the positioning of the heatsink!

As a general rule:

1. Determine the case style of devices to be cooled.
2. Whether the heatsink is the right shape to allow maximum heat transfer.
3. The maximum power likely to be dissipated (can be calculated mathematically).
4. The physical size of the heatsink, which also determines its final positioning, and size of the project.
5. The need for extra ventilation. In enclosed areas, it may be necessary to provide flow-through ventilation slots, or to fit a cooling fan.
6. The total number of devices to be fitted on the heatsink.

If in doubt as to which heatsink to use, fit the largest, most convenient one and monitor the temperature during initial use.

Bolting a heatsink to a large metallic surface area will also add to the heat dissipation and improve cooling, but attaching onto wood or plastic will not achieve this.

Wiring and Terminating

The amount of wiring is kept to a minimum in most projects, especially where IDC-assembled plugs and cables are available. For the occasional wire or screened cable, basic techniques for stripping and tinning etc., are detailed in Figure 12. Where many cables are used between PCB's and external components, e.g. switches and potentiometers, try to use ribbon cable (low voltage, low frequency only), or keep the various wires together in a 'cable-form'.

With cable-forms, connections to different areas along the length of the cable-form are brought out as short loops, and the main form is tied into a bundle with lacing cord, waxed string, plastic cable-ties or spira-wrap. Of these, spira-wrap is easily removeable for alterations, if necessary. Cable-ties are rather permanent, as once they have been applied, their self-locking action makes it necessary to cut them off. It is sometimes possible however to gently prise up the locking tongue using a thin,

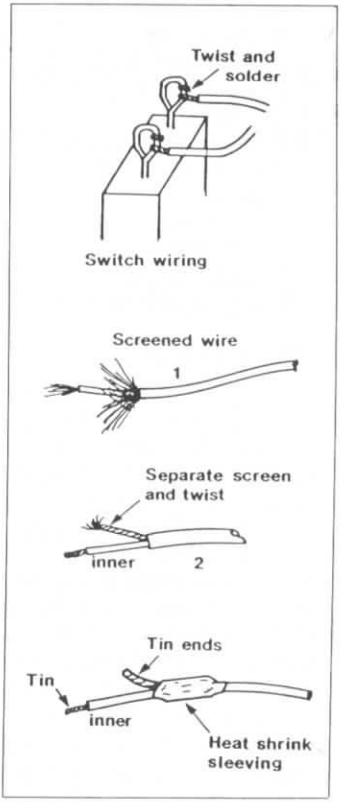


Figure 12a

pointed knife, and then withdraw the band whilst holding off the tongue with the knife point.

Screened cables or signal carrying wires should *not* be incorporated in a cable form which also contains power carrying cables, and separate forms should be made for both. When terminating a wire to solder-tags or Vero pins, first lightly 'tin' the terminal, then wrap the stripped and twisted wire end around the terminal at least one full turn, to ensure a good, strong electrical connection, and solder the assembly.

Beware, too much heat applied to the wire end may cause the plastic wire insulation to melt backwards, thus exposing a portion of bare wire. Fitting sleeving like systoflex or heat shrink will prevent this from happening and can also be used to completely insulate the assembly after soldering. Always try to use different coloured wires where possible, or slip on marker rings made from coloured sleeving at the cable ends. Doing this will greatly decrease the problems of identification in large cable-forms.

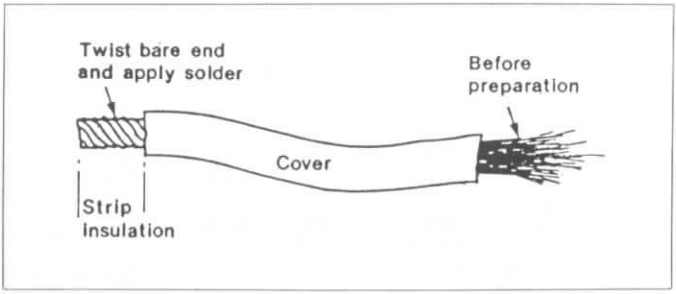


Figure 12c

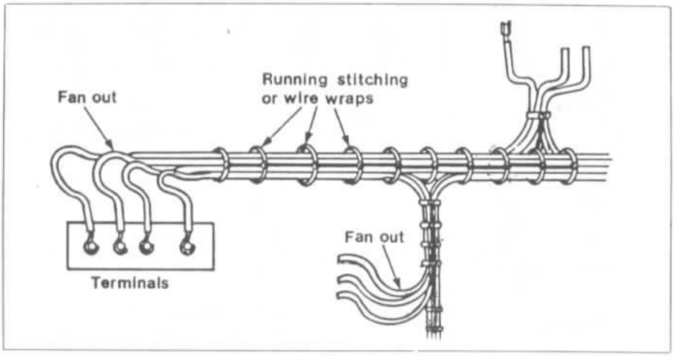


Figure 12d

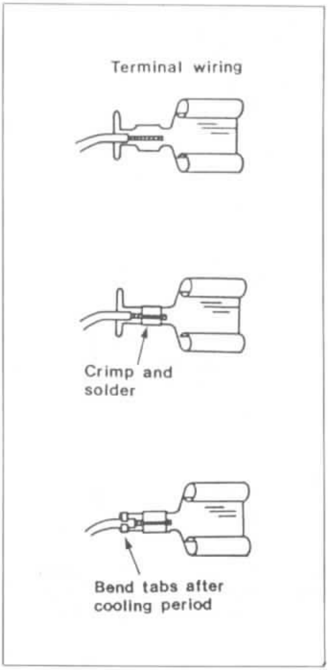


Figure 12b

Connectors such as the ¼in. Lucar type, and Minicon/Latchcon terminals, require the wire to be crimped to the connector. A crimping tool must be used for large fittings, but smaller crimped connectors can be folded and squeezed with electrical pliers, until the conductor appears to be tight. It is then a good idea to just squeeze two or three places along the crimped length with *blunt* wirecutters (preferably), to ensure the metal bites into the conductor, and perhaps soldered for reliability. Note that the rear-most two tongues are to clamp the wire *insulation*. In the case of minicon connectors, do ensure that multiple socket terminals are all level with each other (i.e. if using ribbon cable etc.), and that nothing will foul the socket housing on insertion. If all is well insert them into the socket the correct way round, and push them home until they click.

The same sort of precautions apply to the Lucar connectors if used with push-on covers.

Diagrams and Symbols

Many symbols used in the project are printed with brief descriptions, see Figure 13. In fact, component symbols used in circuit diagrams can vary enormously, and particular devices be drawn in different ways. The standard adopted with all Maplin circuit diagrams rarely changes, although new symbols are added from time to time as the need arises.

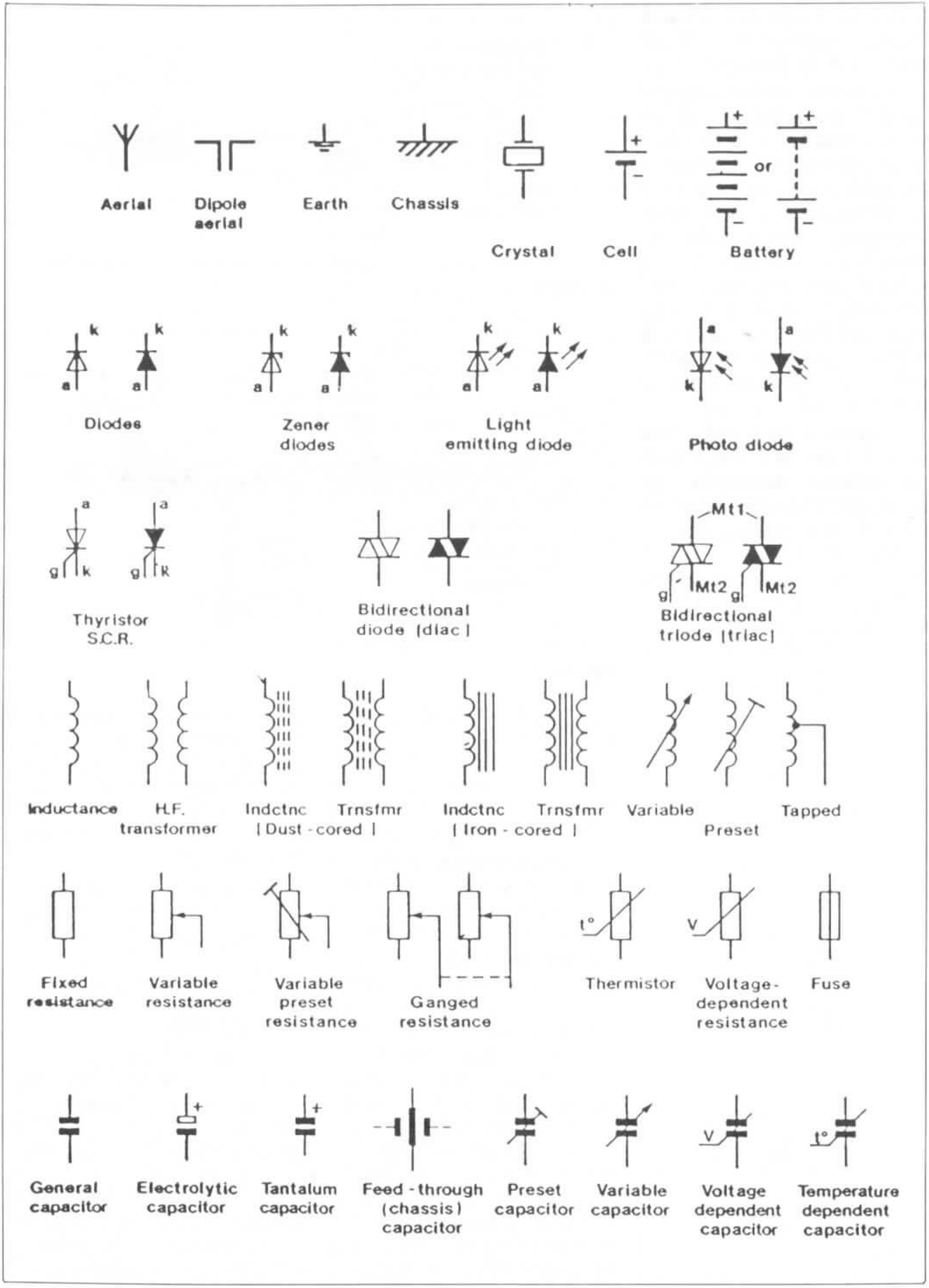
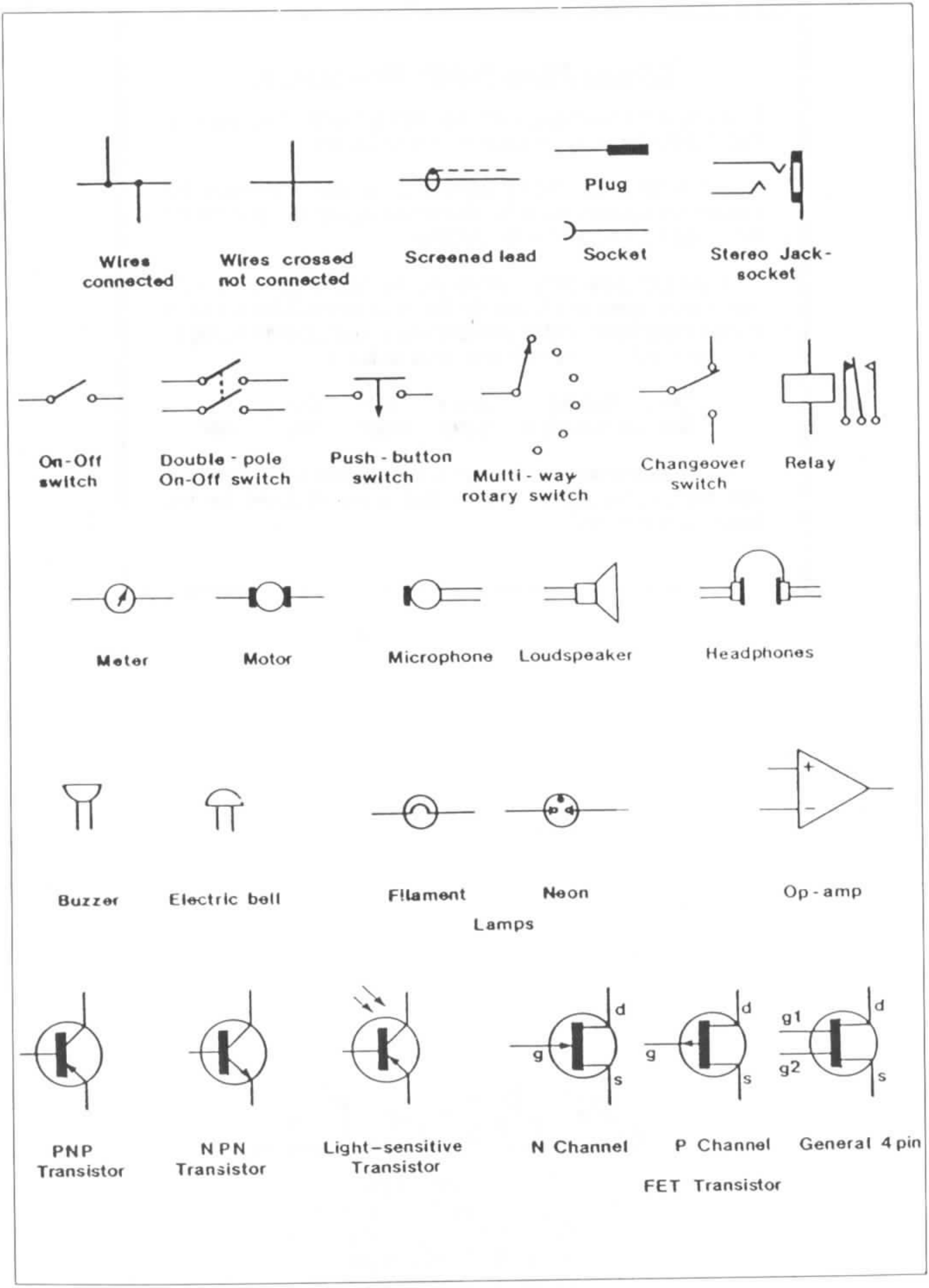

Aerial
Dipole aerial
Earth
Chassis
Crystal
Cell
or
Battery
k
a
Diodes
Zener diodes
Light emitting diode
Photo diode
Thyristor S.C.R.
Bidirectional diode (diac)
Mt1
Mt2
g
Bidirectional triode (triac)
Inductance
H.F. transformer
Indctnc
Trnsfmr
(Dust - cored)
Indctnc
Trnsfmr
(Iron - cored)
Variable
Preset
Tapped
Fixed resistance
Variable resistance
Variable preset resistance
Ganged resistance
t°
Thermistor
V
Voltage-dependent resistance
Fuse
General capacitor
Electrolytic capacitor
Tantalum capacitor
Feed - through (chassis) capacitor
Preset capacitor
Variable capacitor
Voltage dependent capacitor
Temperature dependent capacitor

Figure 13a



Wires connected
Wires crossed not connected
Screened lead
Plug
Socket
Stereo Jack-socket
On-Off switch
Double-pole On-Off switch
Push-button switch
Multi-way rotary switch
Changeover switch
Relay
Meter
Motor
Microphone
Loudspeaker
Headphones
Buzzer
Electric bell
Filament
Neon
Lamps
Op-amp
+
−
PNP Transistor
N PN Transistor
Light-sensitive Transistor
d
g
s
g1
g2
N Channel
P Channel
General 4 pin
FET Transistor

Figure 13b

Metal Film 0·6W Resistors

Please note that two methods of colour coding exist for these resistors. The method of reading the colour code is as follows:

If the *last* colour band is *red* then the resistor conforms to the standard coding method, i.e. the first *two* bands indicate the numerical value, and the third band is the multiplier.

If the *last* colour band is *brown* then the resistor conforms to the new type of coding, which uses the first *three* bands as the numerical value, and the fourth band as the multiplier. An example of the coding for a 10k using both old and new methods is as follows:

Old 10k Marking =	Brown	Black	Orange	
New 10k Marking =	Brown	Black	Black	Red

Unfortunately we do receive a mix of types from our supplier, and until this can be resolved please accept our apologies for any inconvenience caused.

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